A COMPUTATIONAL MODEL OF INVAGINATING TROPHOBLAST TISSUE

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The trophoblast tissue plays a crucial role during the whole pregnancy by mediating the contact between the fetal and maternal circulation systems. It usually forms a smooth regular covering of the chorionic villous trees, the basic structure of the placenta. However, it was shown in the clinical research [1] that in the placentas with known karyotypic abnormalities, deep invaginations of the trophoblast layers can be seen and that there is a strong connection between the trophoblast invaginations and pregnancy complications or birth losses.

In our presentation, a computational model of the mechanics of the growth of the trophoblast tissue is discussed, allowing one to gain a wider view of the dynamic processes occurring inside the placental trophoblast. It is described how this complex system can be modeled successfully using the immersed boundary method [2]. Two-dimensional numerical simulations are also presented to demonstrate the different paths of the development of the trophoblast bilayer. It is shown how the initiation of cell processes (cell proliferation and cell fusion) and their spatial and temporal distributions lead to different shapes of the tissue. This facilitates understanding the conditions in which the mechanics itself can cause such undesired tissue bending.

References
[1] H.J. Kliman, L. French, "Trophoblast inclusions are associated with karyotypic abnormalities",
21st Annual Meeting of the Society for Maternal-Fetal Medicine, Reno NV, 2001.
[2] C.S. Peskin, "The Immersed Boundary Method", *Acta Numerica*, v. 1, p. 1-39, 2002.